

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicants: Honeyman et al.
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Cambridge, Massachusetts
May 24, 2006

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Sir:

This is an appeal from the final rejection of all claims of the above application as set forth in the Office Action mailed October 31, 2005.

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REAL PARTY IN INTEREST

The real party in interest in this appeal is E Ink Corporation, a corporation organized and existing under the laws of the State of Delaware, of 733 Concord Avenue, Cambridge, MA 02138-1002.

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RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

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STATUS OF CLAIMS

Claims 1, 8-20, 35 and 37-42 are pending in this application, the remaining claims having been cancelled. All claims stand finally rejected; no claim is objected to. A copy of the pending claims appears in the Claims Appendix to this Brief.

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STATUS OF AMENDMENTS

All Amendments have been entered; the Advisory Action issued March 7 stated that the Amendment After Final Rejection filed February 27 was being entered.

SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1 of this application is directed to a process for producing a polymer-coated pigment particle dispersed in a fluid to form an electrophoretic medium. The process, the main portion of which is illustrated in Figures 5A and 5C of the drawings, comprises:

- (a) reacting the particle (500) with a reagent (502, 530) having a functional group (504) capable of reacting with, and bonding to, the particle (500), and also having a polymerizable or polymerization-initiating group (506, or the chloromethyl group shown in Figure 5C), thereby causing the functional group (504) to react with the particle (500) surface and attach the polymerizable group (506 etc) thereto to form an intermediate product (508);
- (b) reacting the product (508) of step (a) with at least one monomer or oligomer (ethylene in Figure 5A, methyl methacrylate in Figure 5C) under conditions effective to cause reaction between the polymerizable or polymerization-initiating group (506) on the particle (500) and the at least one monomer or oligomer, thereby causing the formation of polymer bonded to the particle (see the last formulae in each of Figures 5A and 5C, and the polymeric groups at the right hand side of these formulae); and
- (c) dispersing the polymer-coated pigment particle into a suspending fluid to form an electrophoretic medium.

Claim 35, the only other independent claim, is similar to claim 1, but is restricted to the use of titania particles and to the use, in step (a), of a reagent which forms a covalent bond with the titania particle. However, claim 35 does not require dispersal of the polymer-coated titania particle into a suspending fluid.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 8-11, 14 and 15 stand rejected under 35 USC. 103(a) as being unpatentable over Sakai et al (U.S. Patent No. 5,750,258) in view of Uytterhoeven et al (U.S. Patent No. 4,663,265). It is believed that the reasons for this rejection are adequately set forth in the following extracts from the Office Action of April 26, 2005:

Sakai et al discloses a process for producing crosslinked resin-coated silica fine particle (claimed pigment particles) comprising reacting the silane portion of the vinyl-containing silane coupling agent such as vinyltrimethoxysilane, vinyl-triethoxysilane (See column 5, line 20) with the silanol group on the calcined silica fine particle to form a chemical bond (claimed covalent bond), then reacting the vinyl group of the silane coupling agent with the unsaturated double bond of a monomer mixture comprising a monofunctional vinyl monomer (M) and a polyfunctional vinyl monomer (P) with P/M molar ratio of 70/30 mol (See column 7, lines 49-56), for forming the crosslinked resin coating when the monomers are polymerized, to form a chemical bond, whereby a crosslinked resin coating excellent in adhesion is formed on the surface of each calcined silica fine particle through the vinyl-containing silane coupling agent (See column 4, lines 53-67; column 5, lines 1-15, 38-39). The polyfunctional monomers include acrylates and methacrylates of polyhydric alcohols, polyethylene glycol dimethacrylate (claimed monomer having a chain of at least about four carbon atoms attached to a polymerizable group) etc. (See column 8, lines 33-43) (i.e. the polymer formed on the particles would comprise a main chain and a plurality of side chains extending from the main chain, each of the side chains comprising at least about four carbon atoms). . . .

Uytterhoeven et al teach that polymer-coated pigment particle may be used for forming an electrophoretic medium by dispersing into a suspending fluid (See column 2, lines 46-62).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have made polymer-coated pigment particle of Sakai et al for the use in an electrophoretic medium by dispersing into a suspending fluid since Uytterhoeven et al teach that polymer-coated pigment particle may be used for forming an electrophoretic medium by dispersing into a suspending fluid.

Claims 1, 8, 11-13, 19 and 20 stand rejected under 35 USC 103(a) as being unpatentable over Devonport (U.S. Patent No. 6,301,380) in view of Uytterhoeven et al (U.S. Patent No. 4,663,265). The following extract from the Office Action of April 26, 2005 sets out the Examiner's discussion of Devonport:

Devonport discloses in the Background of the Invention that a process for producing a polymer-coated carbon black (claimed pigment) particle comprising growing polymers (with at least one monomer or oligomer) from an activated carbon black surface by first attaching a reactive group via the oxygen groups on the carbon black surface by using glycidyl methacrylate where the glycidyl group reacts with phenolic hydroxyl groups on the carbon black surface providing a vinyl functionality (for claimed radical polymerization); the reaction of 4,4'-azo bis-(4-cyanovaleic acid) whereby the isocyanate group reacts with phenolic hydroxyl groups and subsequent heating decomposes the azo group to generate an alkyl radical (claimed polymerization initiating group); and the reaction of the phenolic hydroxyl groups with butyl lithium which can then be used as an initiation site (claimed polymerization initiating group) for anionic polymerization (See column 1, lines 33-41) thereby causing the formation of polymer (covalently) bonded to the particle, was known in the art.

As to claim 12, Devonport teaches that polymer-coated carbon black can be produced by chemically attaching (See column 8, lines 36-41) groups of formula (II) containing labile halide (See column 2, lines 38-54) such as benzyl chloride (See column 6, line 56) which permits the formation of radical groups (See column 6, lines 46-48),

then reacting these groups with a polymerizable monomer thereby attaching polymers to the attached groups (See column 8, lines 47-62).

As to claim 13, the polymerization reaction thus can produce any length of polymer on the modified particle; and the polymers can be any type, such as homopolymers, co-polymers, ter-polymers, or higher chain polymers, and also can be block, graft, or random-type polymers (See column 9, lines 27-34). It is well known in the art that a block polymer is made by sequentially adding monomers: adding a second monomer after stopping polymerization of a first monomer.

As to claims 19, 20, silica-coated carbon product can also be used as the particle (See column 5, lines 53-54).

Uytterhoeven is used to support this 35 USC 103 rejection in exactly the same way as the earlier 35 USC 103 rejection based upon Sakai and Uytterhoeven, as already discussed above.

Claims 13 and 15-18 stand rejected under 35 USC 103(a) as being unpatentable over Devonport in view of Uytterhoeven and further in view of Matyjaszewski et al., U.S. Patent No. 6,121,371. The following extract from the Office Action of April 26, 2005 sets out the Examiner's discussion of Matyjaszewski:

Matyjaszewski et al teach that any type of polymers including block, branched and comb polymers can be prepared using radical polymerization initiator (See column 1, lines 6-10): block copolymers can be prepared using a pre-formed macroinitiator to initiate the polymerization by sequential addition of monomer: upon the consumption of all or most of a first monomer, a second monomer is added which is then added to the polymer chain (See column 7, lines 45-64); branched and hyperbranched polymers can be prepared by (co)polymerization of AB* monomers. Such monomers have a polymerizable double bond (A) and a functional group that can initiate ATRP (B*), e.g. a radically transferable atom or group (See column 7, lines 65+); and comb shaped polymers can be prepared from macroinitiators that contain a free radically

transferable atom or group on each monomer unit, or regularly along the polymer chain, such that the branches or grafts are forced to physically interact at a molecular level (See column 8, lines 16-24).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have coated a particle in Devonport [now Devonport in view of Uytterhoeven] using techniques of Matyjaszewski et al with the expectation of providing the desired coating of block, branched, or comb polymer, since Devonport further teaches that the polymers can be of any type, such as homopolymers, copolymers, ter-polymers, or higher chain polymers; and they can also be block, graft, or random-type polymers, and Matyjaszewski et al teach that any type of polymers including block, branched and comb polymers can be prepared using radical polymerization initiator.

Claims 35 and 37-42 stand rejected under 35 USC 103(a) as being unpatentable over Katoh et al., U.S. Patent No. 6,514,328, in view of Sakai et al. This rejection is stated as follows in the final Office Action:

Katoh et al disclose a process for producing a polymer-coated pigment powder 20 for dispersing into a suspending fluid to form an electrophoretic medium or liquid crystal device (See column 1, lines 16-20). The process comprises covalently bonding a polymeric layer 21 (See column 17, lines 22-23) such as polymethylacrylate (See column 17, lines 7-8) to the surface of the pigment powder 20 by coating (See column 17, lines 15-21), chemical adsorption using a silane coupling agent such as vinyltriethoxysilane (See column 17, lines 42-43) or graft polymerization (See column 17, lines 28-30) or combination thereof (See column 18, lines 16-21). The pigment includes titanium oxide (See column 17, lines 4-5) or titanium oxide coated with a silicon oxide (See column 17, line 6).

Katoh et al fail to teach that a polymer coating is formed on the surface by copolymerization of a monomer with a polymerizable group of the silane coupling agent.

Sakai et al teach that a polymer layer can be covalently bonded to the surface of a silicon oxide for the use in a liquid crystal device by reacting the silane portion of the vinyl-containing silane coupling agent such as vinyltriethoxysilane (See column 5, line 20) with the silanol group on the silica fine particle to form a chemical bond (claimed covalent bond), then reacting the vinyl group of the silane coupling agent with the unsaturated double bond of a monomer mixture comprising a monofunctional vinyl monomer (M) and a polyfunctional vinyl monomer (P) with P/M molar ratio of 70/30 mol (See column 7, lines 49-56), for forming the crosslinked resin coating when the monomers are polymerized, to form a chemical bond, whereby a crosslinked resin coating excellent in adhesion is formed on the surface of each silica fine particle through the vinyl-containing silane coupling agent (See column 4, lines 53-67; column 5, lines 1-15, 38-39). The polyfunctional monomers include acrylates and methacrylates of polyhydric alcohols, polyethylene glycol dimethacrylate (claimed monomer having a chain of at least about four carbon atoms attached to a polymerizable group) etc. (See column 8, lines 33-43) (i.e. the polymer formed on the particles would comprise a main chain and a plurality of side chains extending from the main chain, each of the side chains comprising at least about four carbon atoms).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed a polymer layer 21 in Katoh et al by copolymerization of a monomer with a polymerizable group of the silane coupling agent as described by Sakai et al with the expectation of providing the desired excellent adhesion of the polymer layer to the surface of each pigment particle through the vinyl-containing silane coupling agent.

Finally, Claims 35-36 and 39-40 stand rejected under 35 USC 102(b) as being anticipated by Herman et al, U.S. Patent No. 3,884,871. This rejection is stated as follows in the final Office Action:

Herman et al disclose a process for producing a polymer-coated titanium dioxide (claimed titania) pigment particles (See column 1, lines 48-52), which process comprises adding an anchoring agent having polar groups which are strongly adsorbed on the pigment surface (See column 3, lines 38-40) and a polymerizable group; adding a monomer such as C₄-C₂₀-branched alkyl esters of acrylic acid (claimed monomer having a chain of at least four carbon atoms attached to a polymerizable group) (See column 4, lines 34-38) for copolymerization with the polymerizable group of the anchoring agent (See column 4, lines 38-46) thereby **bonding** (i.e. *reacting* the polar groups of the anchoring agent with the pigment surface) the coating polymers onto the surface of the pigment (See column 3, lines 28-30).

ARGUMENT

Summary

- (i) Claims 1, 8-11, 14 and 15 are not obvious over Sakai and Utterhoeven because there is no logical way to combine these references;
- (ii) Claims 1, 8, 11-13, 19 and 20 are not obvious over Devonport and Utterhoeven because there is no logical way to combine these references;
- (iii) Claims 13 and 15-18 are not obvious over Devonport, Utterhoeven and Matyjaszewski for the same reasons as in (ii) above;
- (iv) Claims 35 and 37-42 are not obvious over Katoh and Sakai because (a) Katoh describes a wide variety of particles and coatings, and does not contain a clear disclosure of a polymer-coated titania particle; and (b) there is no logical way to combine Katoh and Sakai. and
- (v) Claims 35 and 39-40 are not anticipated by Herman because Herman does not disclose a titania particle having a polymer covalently bonded thereto.

Detailed argument

Summary of prior art and applicants' contribution thereto

Electrophoretic media comprise a plurality of electrically charged particles in a fluid; upon application of an electric field to the fluid, the particles move through the fluid resulting in changes in the appearance of the medium. There may be only a single type of charged particle or two or more types of such particles; when there are two types of charged particles, these types may bear charges of the same or different polarities. The fluid may be transparent or may be dyed. The charged particles and the fluid may be incorporated into a plurality of capsules or otherwise separated into discrete droplets.

Unfortunately, the service life of encapsulated electrophoretic media, of both the single and dual particle types, is lower than is desirable. It appears that this service life is limited by factors such as sticking of the electrophoretic particles to the capsule wall, and the tendency of particles to aggregate into clusters which prevent the

particles completing the movements necessary for switching of the display between its optical states. Opposite charge dual particle electrophoretic media pose a particularly difficult problem, since inherently oppositely charged particles in close proximity to one another will be electrostatically attracted to each other and will display a strong tendency to form stable aggregates. Experimentally, it has been found that if one attempts to produce a black/white encapsulated display of this type using untreated commercially available titania and carbon black pigments, the display either does not switch at all or has a service life so short as to be undesirable for commercial purposes. (For fuller details of this and the following explanation, please see Paragraphs 12-19 of the specification of the application.)

It has long been known that the physical properties and surface characteristics of electrophoretic particles can be modified by adsorbing various materials on to the surfaces of the particles, or chemically bonding various materials to these surfaces. Later, it was found that simple coating of the electrophoretic particles with the modifying material was not entirely satisfactory since a change in operating conditions might cause part or all of the modifying material to leave the surface of the particles, thereby causing undesirable changes in the electrophoretic properties of the particles; the modifying material might possibly deposit on other surfaces within the electrophoretic display, which could give rise to further problems. Accordingly, techniques were developed for securing the modifying material to the surface of the particles.

For example, U.S. Patent No. 5,783,614 (Chen et al.) describes an electrophoretic display using diarylide yellow pigment particles modified with a polymer of pentafluorostyrene. The modified particles are produced by forming a mixture of the unmodified particles, the pentafluorostyrene monomer and a free radical initiator, and heating and agitating this mixture so that the monomer polymerizes *in situ* on the surface of the particles. In such a process, it is difficult to control the amount of polymer deposited on the pigment particles.

U.S. Patent No. 5,914,806 (Gordon II et al.) describes electrophoretic particle formed by reacting pigment particles with a pre-formed polymer so that the polymer becomes covalently bonded to the surface of the particles. This process is of course restricted to pigments and polymers having chemical properties which allow the necessary reaction to form the covalent bond. Furthermore, a polymer with only a few sites capable of reacting with the particle material has difficulty in reacting with the solid interface at the particle surface; this can be due to polymer chain conformation in solution, steric congestion at the particle surface, or slow reactions between the polymer and the surface. Often, these problems restrict such reactions to short polymer chains, and such short chains typically only have a small effect on particle stability in electrophoretic media.

It is also known to use, in electrophoretic displays, particles consisting essentially of polymer; if dark colored particles are required, the polymer particles can be stained with a heavy metal oxide. See, for example, U.S. Patents. Nos. 5,360,689; 5,498,674; and 6,117,368. Although forming the electrophoretic particles from a polymer allows close control over the chemical composition of the particles, such polymer particles usually have much lower opacity than particles formed from inorganic pigments.

Hence, there is a continuing need for processes which can place controlled amounts of polymer on the surfaces of electrophoretic pigment particles, and the present invention seeks to supply this need.

(i) 35 USC 103 Rejection of claims 1, 8-11, 14 and 15 over Sakai and Uytterhoeven

Sakai describes crosslinked resin-coated silica particles, each of which has a crosslinked resin coating formed of one or more layers formed on the surface of each particle through a vinyl-containing silane coupling agent (see the Abstract). The resin-coated silica particles are intended for use as spacers in liquid crystal displays, and are stated to have the advantage that they substantially do not move after the formation of the liquid crystal cell (see the Abstract and, *inter alia*, the last part of Example 1 at column

18, line 42 to column 19, line 16). It should be noted that the failure of the Sakai particles to move when liquid crystal is introduced into the cell indicates that the Sakai particles are not readily dispersed in the organic liquid crystal medium. There is no indication in Sakai that the particles carry any electric charge, and indeed electric charge is irrelevant to particles used as spacers.

Uytterhoeven describes polymer-coated particles useful in an electrophoretic medium, namely a liquid electrophoretic developer composition. However, Uytterhoeven teaches that, to be useful in such an electrophoretic composition, the particle must have a specific two-part polymer structure, namely at least one polymer ("polymer A") which forms a coating on the pigment (apparently a dried physical coating, judging from the Examples of Uytterhoeven, rather than a chemically-bonded coating as in Sakai) and has poor solubility in the suspending fluid of the electrophoretic composition, and a second polymer ("polymer B") chemically linked to polymer A and having good solubility in the suspending fluid of the electrophoretic composition.

There is no logical way in which a skilled person would combine Sakai and Uytterhoeven to produce a process in accordance with present claim 1. The requirements for spacer particles used in liquid crystal displays are very different from those for electrophoretic particles; for example, the ability to carry an electric charge is irrelevant to the former, but crucial in the latter, while spacer particles should not be readily dispersible in the liquid crystal medium whereas electrophoretic particles need to be dispersible in the suspending fluid. Accordingly, there is no reason why, *a priori*, a skilled person would attempt to use the Sakai particles in an electrophoretic medium. As already noted, Uytterhoeven teaches that a particular two-layer polymer coating, which the Sakai particles do not possess, is needed for electrophoretic particles. Accordingly, there is no logical reason why Uytterhoeven would lead a skilled person to try the Sakai particles in an electrophoretic medium.

(ii) 35 USC 103 Rejection of claims 1, 8, 11-13, 19 and 20 over Devonport and Uytterhoeven

The situation regarding this rejection is similar to the preceding rejection. Devonport describes, in his "Background of the Invention" section, prior art relating to growing polymers on carbon black surfaces. The polymer-coated carbon black particles produced are intended as thermal stabilizers in polymeric systems (see column 1, lines 12-18 of Devonport). Devonport then proceeds to describe improved methods for attaching polymers to carbon black particles, apparently for the same purpose. Again, there is no logical reason why a skilled person would put Devonport and Uytterhoeven together to produce a process in accordance with present claim 1. The requirements for particles used as thermal stabilizers in polymers are very different from those for electrophoretic particles; for example, the ability to carry an electric charge is irrelevant to the former, but crucial in the latter. Accordingly, there is no reason why, *a priori*, a skilled person would attempt to use the Devonport particles in an electrophoretic medium. As already noted, Uytterhoeven teaches that a particular two-layer polymer coating, which the Devonport particles do not possess, is needed for electrophoretic particles. Accordingly, there is no logical reason why Uytterhoeven would lead a skilled person to try the Devonport particles in an electrophoretic medium.

(iii) 35 USC 103 Rejection of claims 13 and 15-18 over Devonport, Uytterhoeven and Matyjaszewski

This rejection is traversed for exactly the same reasons as the previous rejection based upon Devonport and Uytterhoeven alone. There is nothing in Matyjaszewski to teach the skilled person to combine Devonport and Uytterhoeven.

(iv) 35 USC 103 Rejection of claims 35 and 37-42 over Katoh and Sakai

This rejection is traversed on the grounds that (a) Katoh describes a wide variety of particles and coatings, and does not contain a clear disclosure of a polymer-coated titania particle; and (b) there is no logical way to combine Katoh and Sakai.

With regard to point (a), Katoh teaches an unusual type of single particle electrophoretic medium using two mutually immiscible suspending fluids (X and Y in Figures 1A-1C and 2), one of these two fluids (X) containing a dye (A) which is

insoluble in the other fluid (Y). The medium further contains solid particles of a pigment (B) which can move between the immiscible suspending fluids. Katoh states that

"when a titanium oxide powder is used as the pigment powder, preferable examples of the material for use in the coating layer 21 are silicon oxide, aluminum oxide, polyethylene, phenolic resin, poly(methyl acrylate), melamine resin, urea resin, Teflon resin, poly(vinylidene fluoride), polyvinyl alcohol, and polyethylene oxide. When a nylon powder is used as the pigment powder 20, preferable examples of the material for use in the coating layer 21 are titanium oxide and aluminum oxide. These materials may be used alone or in combination."(column 17, lines 4-14).

Katoh subsequently states that in his Figure 4C, a layer is provided on the surface of a pigment powder 20 [the material forming this powder is not specified] by covalent bonding, and that the affinity of a dye solution or dye for the pigment powder 20 can be adjusted by selecting ions of a chemically adsorbed material (A-B) 22, and properties of the side chain or end group of the material 22. Katoh further states that the above-mentioned chemical adsorption can be attained by titanium coupling, silane coupling, aluminum coupling, or graft polymerization, and that the pigment powder may be previously subjected to any of the above-mentioned treatments, or a reaction reagent may be added to the dispersion media in advance. Katoh then proceeds to recite numerous specific reagents which may be used in titanium coupling, silane coupling, and aluminum coupling.

In other words, Katoh teaches numerous coatings specifically intended for titania, none on which meet the requirements of any of the present claims, and numerous reagents which may be used to produce coatings on (unspecified) pigment particles. There is no clear disclosure of any titania particle bearing a coating as required by present claim 35, and the Examiner's analysis attempts to "cherry-pick" various disparate

parts of the disclosure which support the rejection while ignoring the contexts of these disparate parts

With regard to point (b), there is no logical way to combine Katoh and Sakai. As noted above, Sakai is explicitly restricted to silica particles, which are shown to have the right physical properties for use as spacers in liquid crystal displays. There is no logical reason why a skilled person, seeking to improve the Katoh coated titania particles, would assume that Sakai is relevant. Sakai is concerned solely with controlling the surface properties of silica particles to render them more suitable for use as spacers in liquid crystal displays, whereas Katoh is concerned with coating titania particles to adjust their relative affinities for two immiscible suspending fluids (typically water and hydrocarbon) in an electrophoretic display. (The reference to liquid crystals in Katoh is solely by way of acknowledging prior art in the area of electro-optic displays; the Katoh displays are electrophoretic displays, not liquid crystal ones, and there is no suggestion in Katoh that liquid crystals can usefully be used as either of his suspending fluids.) Given the major differences in both the materials being coated and the liquid in which the coated particle is to be used, there is no logical reason why the skilled person would assume that the type of coating described in Sakai would be useful in the Katoh displays.

(v) 35 USC 102 Rejection of claims 35 and 39-40 as anticipated by Herman

Herman does not disclose a process in which a reagent is bonded to a titania particle via a covalent bond, as required by all of claims 35 and 39-40.

Herman (in so far as relevant for present purposes) describes a process for the coating of titania pigment particles, in which there is added to a water slurry of titania a polyanionic dispersing agent, the slurry is diluted until it contains 15 to 30% of titania, and then there is added to the diluted slurry an anchoring agent comprising an organic vinyl monomer *containing polar groups which are adsorbed on to the surface of said [titania] particles* (see Herman claim 1, emphasis added). The italicized wording clearly shows that in the Herman process the "anchoring agent" is simply adsorbed on to the

titania surface by ionic interactions and is not bonded to the surface via a covalent bond, as required by present claims 35 and 39-40. Hence, Herman cannot anticipate any of the present claims.

This distinction between the present claims and Herman is not merely a matter of design choice. Herman's titania is intended for use in paints, especially latex paints and plastics (see, for example, column 1, lines 5-52). In such media, and especially in aqueous latex paints, there is little tendency for a polymer coating formed on the titania particle to become detached from the particle. In contrast, the coated titania particles of the present invention are intended for use in electrophoretic media, which typically use organic suspending fluids (see, for example, Examples 26 and 27 of the present application). In such media, there is a much greater risk of a polymer held on to the titania particle only by adsorption becoming detached from the particle (cf. Paragraph 13 of the present specification) with undesirable consequences.

In the Advisory Action, the Examiner has attempted to argue that various references to "bonding" in Herman show that the anchoring agent does in fact form a covalent bond with the titania surface. However, it is respectfully submitted that the passage from claim 1 quoted above, and the discussion of the anchoring agent at column 3, lines 28 to 48 of Herman leave no doubt as to the nature of the bond formed between the anchoring agent and the titania surface.

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For all of the foregoing reasons, the rejections of the claims on appeal should be reversed and the application allowed.

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CLAIMS APPENDIX

Claims on Appeal

1. A process for producing a polymer-coated pigment particle, which process comprises:

- (a) reacting the particle with a reagent having a functional group capable of reacting with, and bonding to, the particle, and also having a polymerizable or polymerization-initiating group, thereby causing the functional group to react with the particle surface and attach the polymerizable group thereto;
- (b) reacting the product of step (a) with at least one monomer or oligomer under conditions effective to cause reaction between the polymerizable or polymerization-initiating group on the particle and the at least one monomer or oligomer, thereby causing the formation of polymer bonded to the particle; and
- (c) dispersing the polymer-coated pigment particle into a suspending fluid to form an electrophoretic medium.

8. A process according to claim 1 wherein, in step (a) the polymerizable group is bonded to the particle surface via a covalent bond.

9. A process according to claim 8 wherein the reagent used in step (a) comprises a silane coupling group and an ethylenically unsaturated group.

10. A process according to claim 9 wherein the reagent used in step (a) comprises a trialkoxysilane coupling group.

11. A process according to claim 1 wherein, in step (a) there is attached to the pigment particle a group which provides an initiating site for atom transfer radical polymerization, and in step (b) the product of step (a) is treated with an atom transfer radical polymerizable monomer to form the polymer.

12. A process according to claim 11 wherein the initiating site comprises a benzylic halogen atom.

13. A process according to claim 11 wherein step (b) is carried out by treating the product of step (a) with a first atom transfer radical polymerizable monomer under conditions effective to cause polymerization of this monomer on to the particle, stopping this first polymerization, and thereafter treating the particle with a second atom transfer radical polymerizable monomer under conditions effective to cause polymerization of this monomer on to the particle, thereby forming a block copolymer of the two monomers on the particle.

14. A process according to claim 1 wherein, in step (a) a polymerizable group is attached to the particle, and in step (b) the product of step (a) is contacted with at least one monomer or oligomer under conditions effective to cause polymerization of the monomer or oligomer with the polymerizable group on the polymer, thereby causing formation of the polymer on the particle.

15. A process according to claim 14 wherein the at least one monomer or oligomer used in step (b) comprises at least one monomer or oligomer having a chain of at least about four carbon atoms attached to a polymerizable group, whereby the polymer formed on the particles comprises a main chain and a plurality of side chains extending from the main chain, each of the side chains comprising at least about four carbon atoms.

16. A process according to claim 14 wherein the at least one monomer or oligomer used in step (b) comprises at least one monomer or oligomer comprising a group capable of initiating polymerization but which essentially does not initiate such polymerization under the conditions used in step (b), and following step (b) the polymer-bearing particle is contacted with at least one monomer or oligomer under conditions which cause the group capable of initiating polymerization to initiate polymerization of the at least one monomer or oligomer, thereby causing the formation of a branched-chain polymer on the particle.

17. A process according to claim 16 wherein the group capable of initiating polymerization is a group capable of initiating atom transfer radical polymerization.

18. A process according to claim 16 wherein the group capable of initiating polymerization is a group capable of initiating stable free radical polymerization.

19. A process according to claim 1 further comprising depositing at least one of silica and alumina on the pigment particle prior to step (a).

20. A process according to claim 19 wherein silica is deposited on the particle prior to step (a), the deposition being effected such that substantially the entire surface of the pigment particle is covered by the silica.

35. A process for producing a polymer-coated titania particle, which process comprises:

(a) reacting the titania particle with a reagent having a functional group capable of reacting with, and forming a covalent bond to, the particle, and also having a polymerizable or polymerization-initiating group, thereby causing the functional group to react with the particle surface and attach the polymerizable group thereto via a covalent bond; and

(b) reacting the product of step (a) with at least one monomer or oligomer under conditions effective to cause reaction between the polymerizable or polymerization-initiating group on the titania particle and the at least one monomer or oligomer, thereby causing the formation of polymer bonded to the titania particle.

37. A process according to claim 35 wherein the bifunctional reagent used in step (a) comprises a silane coupling group.

38. A process according to claim 37 wherein the bifunctional reagent used in step (a) comprises a trialkoxysilane coupling group.

39. A process according to claim 35 wherein, in step (a) a polymerizable group is attached to the titania particle, and in step (b) the product of step (a) is contacted with at least one monomer or oligomer under conditions effective to cause polymerization of the monomer or oligomer with the polymerizable group on the polymer, thereby causing formation of the polymer on the titania particle.

40. A process according to claim 39 wherein the at least one monomer or oligomer used in step (b) comprises at least one monomer or oligomer having a chain of at least about four carbon atoms attached to a polymerizable group, whereby the polymer formed on the particles comprises a main chain and a plurality of side chains extending from the main chain, each of the side chains comprising at least about four carbon atoms.

41. A process according to claim 35 wherein the titania particle used in step (a) is coated with silica.

42. A process according to claim 35 further comprising dispersing the polymer-coated titania particle into a suspending fluid to form an electrophoretic medium

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EVIDENCE APPENDIX

[None]

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[None]